

Taxonomic Status and Distribution of *Apodemus mystacinus* (Danford and Alston, 1877) (Mammalia: Rodentia) in Turkey

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Abstract: Morphological, biometrical, karyological, bacular and phallic aspects of *Apodemus mystacinus* populations in Turkey were studied based on 117 specimens. The biometrical and phallic comparisons confirmed the distinctness of *A. m. mystacinus* and *A. m. epimelas*. The UPGMA tree divided populations in Turkey into 2 groups. The distance (D) between *A. m. mystacinus* and *A. m. euxinus* was 0.469. *A. m. mystacinus* had karyotypic values of $2n = 48$, $NFa = 50$, and $NF = 52$. Being different from *A. m. epimelas*, there was a short groove in the dorsal view of the phallus in populations of *A. m. mystacinus* in Turkey.

Key Words: *Apodemus mystacinus*, Taxonomy, Karyology, Baculum, Phallus, Turkey.

Türkiye'deki *Apodemus mystacinus* (Danford and Alston, 1877) (Mammalia Rodentia)'un Taksonomik Durumu ve Yayılışı

Özet: 117 örneğe dayanarak Türkiye'deki *Apodemus mystacinus* populasyonlarının morfolojik, biyometrik, karyolojik, bakulum ve fallus özellikleri çalışıldı. Biyometrik ve fallus karşılaştırmaları *A. m. mystacinus* ve *A. m. epimelas*'in farklılığını ortaya koydu. UPGMA dendrogramına göre *A. m. mystacinus*'un Türkiye'deki populasyonları iki gruba ayrıldı. *A. m. mystacinus* ile *A. m. epimelas* arasındaki mesafe (D) 0.469 olarak hesap edildi. *A. m. mystacinus*'un $2n = 48$, $NFa = 50$ ve $NF = 52$ 'lik karyolojik değerlere sahip olduğu belirlendi. *A. m. mystacinus*'un populasyonlarında *A. m. epimelas*'tan farklı olarak fallusun dorsalinde bir oluk tespit edildi.

Anahtar Sözcükler: *Apodemus mystacinus*, Taksonomi, Karyoloji, Bakulum, Fallus, Türkiye

Introduction

The rock mouse, *Apodemus mystacinus* was described by Danford and Alston (1877) from Sebil. It lives in rocky areas, forested areas with rocks, and rocky areas covered with small bushes, extending from sea level to an altitude of about 2700 m. It is distributed in Greece, Yugoslavia, Bulgaria, Syria, Lebanon, Palestine, Iraq and the Caucasus (Ellerman and Morrison-Scott, 1951; Corbet, 1978; Musser and Carleton, 1993). *A. m. mystacinus* has 5 subspecies: *A. m. mystacinus* Danford and Alston, 1877 from Sebil in southern Turkey, *A. m. epimelas* Nehring, 1902 from Greece and the Ionian Islands, *A. m.*

smyrnensis Thomas, 1903 from western Turkey, *A. m. rhodius* Festa, 1914 from Rhodes and Crete, and *A. m. euxinus* Allen, 1915 from Altındere (Trabzon) in northern Turkey. Neuhäuser (1936) reported *A. m. mystacinus* from the Taurus, *A. m. smyrnensis* from western Turkey and the Taurus, and *A. m. euxinus* from an area extending from Artvin to Soğukpınar (Bursa). Ellerman (1948) evaluated *A. m. rhodius* and *A. m. smyrnensis* as synonymous with *A. m. mystacinus*. According to Ellerman and Morrison-Scott (1951), *A. m. euxinus* is a distinct subspecies, and *A. m. smyrnensis* is synonymous with *A. m. mystacinus*. Mezhzherin (1997) evaluated *A. epimelas* as a different species. This was also supported

by Filippucci et al. (2002), based on allozymic analysis. Vohralík et al. (2002) confirmed the validity of *A. m. mystacinus* and *A. m. epimelas*, but not the validity of *A. m. euxinus* from Altındere (Trabzon). According to Vohralík et al. (2002), Asian populations of *A. mystacinus* are fairly homogeneous. As is obvious from works cited above, the taxonomic status of *A. mystacinus* in Turkey is open to question.

The aim of the present study is to contribute to taxonomy of *A. mystacinus* along with the subspecific status of *A. m. euxinus* in Turkey.

Materials and Methods

A total of 117 specimens were collected in 1996-2002 from 17 localities in Turkey (Figure 1).

Antalya: Akseki 4, Çıgılıkara 10; Artvin: Ardanuç 12; Aydın: Buharkent 5; Bilecik: Bozüyük 3; Burdur: 1; Bursa: Uludağ 10; Düzce: Akçakoca 6; Hatay: Kırıkhan 2; İzmir: Kemalpaşa 3; Kahramanmaraş: Göksun 2; Kilis: 2; Konya: Beyşehir 5; Manisa: Akhisar 5, Mersin: Çamalan 5, Sebil 16; Trabzon: Altındere 19. We reduced the 17 localities to 11 to constitute a UPGMA phenetic tree. ALD: Altındere, SEB: Sebil, GKK: SE Turkey, ARD: Ardanuç, AKC: Akçakoca, ULD: Uludağ, AKS: Akseki, ÇAM: Çamalan, ÇİĞ: Çıgılıkara; BEB: Beyşehir-Burdur, AYİ: Aydın-İzmir-Manisa.

Adult specimens were used in biometrical evaluations. The NTSYS-pc (Version 1.8) package was used for statistical analyses (Rohlf, 1994). The UPGMA tree was prepared based on 27 skull and body measurements. Body measurements were taken from recently dead-bodies in the field accurate to the nearest millimeter, and skull measurements were taken from skulls cleaned using chemical procedures and were accurate to 0.1 mm. L: Total length, T: Tail, HF: Hind foot, E: Ear, W: Weight, ZB: Zygomatic breadth, IC: Interorbital constriction, CBL: Condylbasal length, ONL: Occipito-nasal length, BL: Basal length, NL: Nasal length, NW: Nasal width, FLB: Facial length of braincase, BCL: Braincase length, HBB: Height of braincase with bullae, HB: Height of braincase without bullae, OW: Occipital width, BW: Braincase width, MB: Mastoid breadth, D: Diastema, PL: Paletal length, IL: Incisiva length, TB: Tympanic bulla length, ML: Mandible length, LUT: Length of upper toothrow cusp, LUTa: Length of upper toothrow alveoli, LLT: Length of lower toothrow cusp, LLTa: Length of lower toothrow alveoli.

Animals were karyotyped using the technique of Ford and Hamerton (1956). Phallus preparations were performed according to Lidicker (1968). The dried phalli were hydrated, cleared by 4% KOH in a day, dried with Alizarin Red S, and transferred from a series of 25%, 50% and 75% to 100% glycerin. Phalli were examined under water. In addition, after some dried specimens were boiled in a solution of 10% ammonia, the bacula

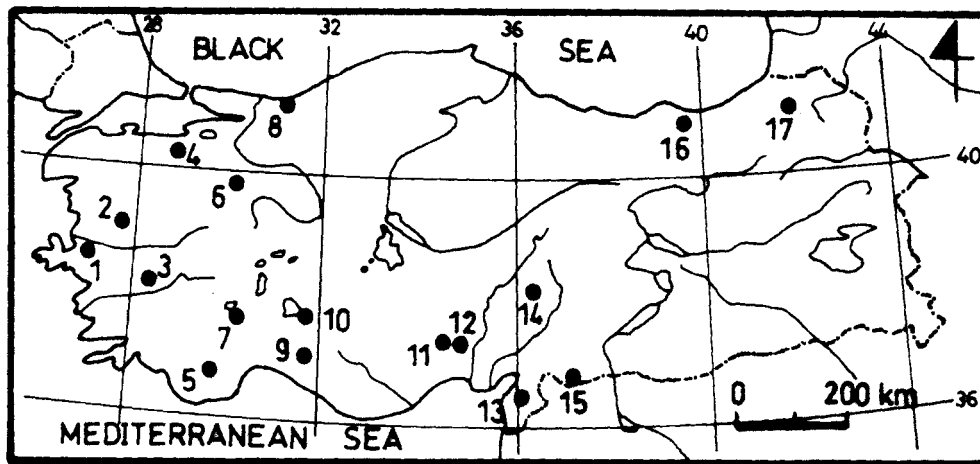


Figure 1. Map showing distribution areas of *A. mystacinus* in Turkey.
 1 Kemalpaşa, 2 Akhisar, 3 Buharkent, 4 Uludağ, 5 Çıgılıkara, 6 Bozüyük, 7 Burdur, 8 Akçakoca, 9 Akseki, 10 Beyşehir, 11 Sebil, 12 Çamalan, 13 Kırıkhan, 14 Göksun, 15 Kilis, 16 Altındere, 17 Ardanuç.

were removed. The skulls and skins were deposited at the Department of Biology, Faculty of Science, Ankara University.

Results

Coloration: We examined coloration patterns in 21 (n = 8 skins) specimens from the type locality of *A. m. mystacinus*. In these specimens, there was variation in coloration with age. In 5 specimens, the fur on the dorsal was light brown with a pale yellowish tinge. In 4 specimens, the dorsal side was reddish light brown. Underparts were pure white (n = 4) or grayish white (n = 4). We compared specimens collected from other localities in Anatolia with those from the type locality of *A. m. mystacinus*, and found that skins from Uludağ (n = 6), İzmir and Aydın (n = 7), Akseki (n = 11), Çamalan (n = 4), Çığılıkara (n = 3), and SE Anatolia (n = 6) were similar to those from the type locality of *A. m. mystacinus*. Ten specimens from Ardanuç in SE Turkey were similar to both populations of Anatolia. We also examined 19 specimens from the type locality of *A. m. euxinus*. The fur on the dorsal was darker (dark brown with a reddish or yellowish tinge) than that of *A. m. mystacinus*. Underparts were whitish with grayish areas at the base of hairs, with a yellowish tinge. Six specimens from Akçakoca were similar to those from Altındere. There was no variation in the skulls of *A. mystacinus* in Anatolia.

Biometrical Comparisons: Body and skull measurements of *A. mystacinus* are shown in Table 1. We examined specimens from 11 localities in Turkey, using NTSYS-pc. As shown in the UPGMA tree (Figure 2), populations from Anatolia were separated into 2 groups. One group is composed of populations from Sebil, Uludağ, Çamalan, and Çığılıkara, and the other group contains populations from Akseki, Aydın-İzmir-Manisa, and Ardanuç. The population from Altındere was different from the other populations. The distance values (D) between populations in Anatolia varied within the range 0.316 to 0.604. The distance (D) between the population from Altındere and that from Sebil was 0.469. The greatest distance was 0.604, between the population from Akçakoca and that from SE Turkey (Table 2). According to biometrical comparisons, condylobasal length distinguishes *A. m. epimelas* from the group *A. m.*

mystacinus-*A. m. euxinus*-*A. m. symrnensis*-*A. m. rhodius*. In particular the population from Sebil is well-separated from *A. m. epimelas* (Figure 3). *A. m. epimelas* has greater values of skull and body measurements than those of the other subspecies, and the ear of *A. m. mystacinus* is longer than that of *A. m. euxinus* (Table 3).

Karyology: 21 specimens from Altındere, Sebil, Akçakoca, Ardanuç, Beyşehir, Akseki, and Aydın were karyotyped. Specimens from those localities have the same karyotypic values. The diploid number of chromosomes is $2n = 48$, the number of autosomal arms is $NFa = 50$, and the fundamental number is $NF = 52$. The autosomal set consists of 4 metacentrics, and 42 acrocentrics. The X chromosome is a large acrocentric, and the Y chromosome is a medium-sized acrocentric (Figure 4).

Phallus and Baculum: The phalli and bacula of specimens collected from Sebil, Çamalan, Altındere, Uludağ, Hatay, Ardanuç, and Beyşehir were examined. The proximal section of the phallus is shorter than the distal section. The margins of the distal section are bulbous. The proximal section is expanded in ventral view. There is a marked ridge in distal section on the dorsal side of the phallus. This ridge contains a short groove near the terminal crater. There is a groove extending along the ventral side of the phallus. In lateral view, there is a considerable depression between the distal and proximal sections (Figure 5). Nodules and spines are present over the entire phallus (Figure 5, D)

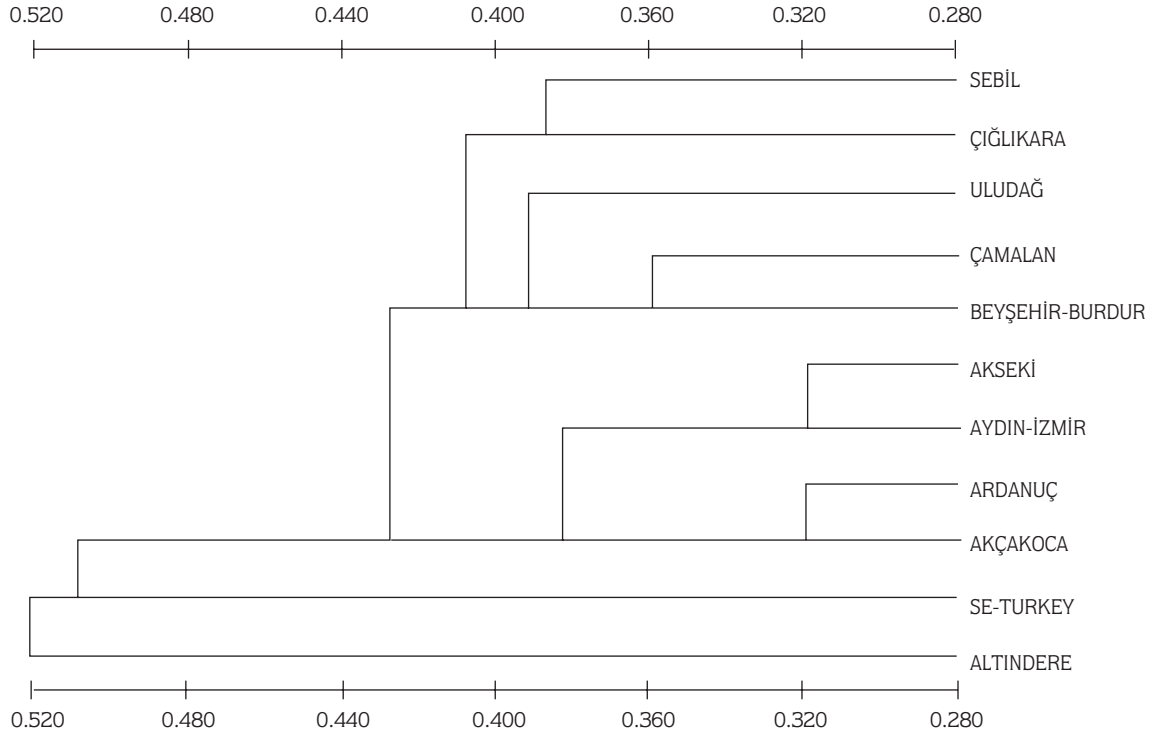
The baculum of *A. mystacinus* is in 2 parts. The cartilaginous part is attached to the distal end of the bone. The cartilaginous part was removed during preparation. The proximal part is spoon-shaped, and composed of a shaft and base. The shaft is broadened towards the base, and moderately expanded in the middle section. In lateral view, the proximal part is curved. The base is concave in both ventral and dorsal (Figure 6).

Discussion

According to Danford and Alston (1977), the upper part of type specimens of *A. mystacinus* is mouse-gray, and washed with along the back, the under parts are pure white, and the line of demarcation is well marked. In

Table 1. The mean and range (bracket) of body and skull measurements (mm) of *A. mystacinus* in Turkey. (C: Characters; L: Localities). See text for explanation of locality (population) abbreviations.

C	L	SEB	ULD	AKS	ÇAM	ÇİĞ
L		238 (215-261)	237.3 (215-250)	239.4 (234-255)	232.2 (219-248)	236 (230-240)
T		125.73 (115-137)	122.7 (115-135)	123.4 (117-135)	121.2 (115-130)	118.5 (115-122)
HF		26.3 (25-28)	26.6 (25-28)	26.7 (26-28)	26.4 (26-27)	26 (25-27)
E		21 (18-25)	21.2 (19-25)	21.1 (20-23)	20.6 (19-22)	21.7 (20-23)
W		34 (20-52)	35.6 (21-52)	34.2 (30-41)	33.8 (25-42)	44.2 (32-52)
ZB		14.8 (14-15.5)	15.7 (15.2-16.2)	14.4 (13.8-15.1)	14.7 (14.1-15.2)	14.6 (14.3-15)
IC		4.5 (4.4-4.7)	5 (4.8-6)	4.7 (4.5-5)	4.8 (4.5-5)	4.83 (4.8-4.9)
CBL		26.8 (26.1-28)	27 (26-27.8)	27.4 (26.9-28.2)	26.9 (26.1-28.2)	27.4 (26.8-28)
OW		30.4 (29.7-31.5)	30.4 (28.5-32)	31 (30.5-31.5)	30.7 (30.1-31.8)	30.8 (30.5-31.5)
BL		25 (24-26.1)	24.7 (24-26)	25 (24.4-26.2)	24.8 (24-26.1)	25 (24-26)
NL		11.3 (10.5-12.1)	11.6 (10-12.9)	12 (11-12.6)	11.6 (11.5-12.2)	11.7 (11.5-12.2)
NW		3.7 (3.6-3.9)	3.7 (3.5-4)	3.7 (3.2-3.9)	3.4 (3.3-3.8)	3.86 (3.8-3.9)
FLB		15.5 (14-16.7)	16 (15.5-17.2)	16.1 (15.5-16.8)	15.6 (14.8-16.4)	15.46 (15.4-15.5)
BRL		13.8 (13.5-14.1)	13.9 (13.5-14.2)	13.9 (13.2-14.5)	14.1 (14-14.5)	13.7 (13.5-14.2)
MW		7 (6.5-7.3)	7 (7-7.1)	7 (6.6-7.2)	7.1 (7-7.2)	7.01 (7-7.1)
BHT		10.4 (10.2-10.8)	10.6 (10-11)	10.4 (10-11.2)	10.2 (10.1-10.5)	10.4 (10.2-10.5)
BH		9.3 (9.2-9.9)	9.2 (8.6-9.5)	9.1 (8.4-9.6)	9.3 (9-10)	9.1 (9.1-9.1)
OW		11.5 (11.3-11.8)	12 (11.5-12.9)	12 (11.6-12.2)	12.1 (12-12.2)	11.7 (11-12.3)
BW		13.5 (13.2-13.8)	13.4 (12.2-14)	13.4 (13.1-14.1)	13.8 (13.5-14)	13.2 (13-13.5)
D		7.8 (7.6-8.2)	7.8 (7.4-8)	7.9 (7.9-8.1)	7.5 (7.1-8)	8 (8-8)
P		13.5 (13.2-14.2)	13.2 (13-13.8)	13.5 (13.1-13.9)	12.9 (12.5-13.4)	13 (12.5-13.4)
I		6.4 (6.1-6.7)	6.4 (6.3-6.6)	6.3 (6-6.5)	6.3 (6.2-6.5)	6.36 (6.3-6.5)
TBL		4.8 (4.6-5.2)	4.7 (4.6-4.9)	5.1 (4.9-5.5)	5 (4.9-5.2)	5.1 (4.9-5.2)
ML		17.3 (16.5-18)	16.8 (16.1-17.2)	17.1 (16.4-17.6)	16.8 (16.3-17.5)	17.2 (16.8-17.9)
LUTa		4.8 (4.7-4.9)	4.8 (4.7-5.2)	4.9 (4.7-5.2)	4.8 (4.6-4.9)	4.63 (4.6-4.7)
LUT		4.4 (4.3-4.6)	4.38 (4.3-4.6)	4.4 (4.3-4.6)	4.4 (4.3-4.6)	4.3 (4.3-4.3)
LLTa		4.7 (4.6-4.9)	4.8 (4.7-4.9)	4.75 (4.7-4.9)	4.74 (4.7-4.9)	4.7 (4.7-4.7)
LLT		4.5 (4.3-4.6)	4.65 (4.6-4.7)	4.5 (4.3-4.6)	4.6 (4.6-4.6)	4.6 (4.6-4.6)
BEB	AYI	GKK	ALD	ARD	AKC	
235 (235-235)	244 (227-255)	229 (210-255)	240 (220-265)	238 (220-254)	245 (243-248)	
125 (125-125)	128 (120-136)	116.8 (105-132.9)	124 (112-142)	126.1 (110-137)	127.5 (122-133)	
26.2 (25-27)	26.6 (26-27)	26 (24-27)	26 (25-28)	26.7 (26-28)	26 (25-27)	
20.5 (19-22)	19.3 (18-20)	20.1 (18-22)	19.5 (16-22)	20.5 (18-23)	22 (21-23)	
33 (29-39)	37.3 (31-43)	38.2 (31-47)	34.8 (23-42)	35.8 (26-45)	35 (28-42)	
15.1 (14.5-16)	15.15 (15.1-15.2)	14.9 (14.5-15.1)	15.5 (15-16)	15.1 (15-15.5)	15.4 (14.8-16)	
4.8 (4.5-5)	4.96 (4.9-5)	4.8 (4.5-5)	4.5 (4.1-5.1)	4.6 (4.4-4.9)	4.6 (4.5-4.9)	
27.1 (26.5-27.6)	27.4 (26.1-28.1)	26 (25.5-27.5)	26.8 (26.5-27)	27.4 (27-28)	27.6 (27.1-28.2)	
30.8 (30.1-31.6)	30.5 (29.5-31.2)	30.5 (28.5-31.2)	30.2 (29.5-31)	30.7 (30-31.6)	30.8 (30.2-31.6)	
24.9 (24.4-25.2)	25.1 (24-25.8)	24.6 (23.5-25.5)	25.6 (24.9-27)	25 (24.4-26.1)	25.3 (25.5-25.6)	
11.5 (10.5-12.5)	11.9 (11.7-12.1)	11.5 (10.6-12.5)	11.7 (10.7-12.9)	11.5 (10.5-12.1)	11.7 (11.2-12.1)	
3.8 (3.5-4.1)	3.9.3 (3.9-4)	3.4 (3.2-4)	3.9 (3.7-4.1)	3.9 (3.5-4.3)	3.93 (3.9-4)	
15.9 (15.6-16.1)	16.1 (15.5-16.5)	15.9 (14.5-16.5)	15.7 (15.5-16.2)	16.1 (15-16.8)	16.1 (16-16.4)	
14.12 (14.1-14.2)	13.8 (13.3-14.2)	14 (13.4-14.6)	13.2 (13-13.5)	13.9 (13.5-14.4)	14.1 (14-14.2)	
7.2 (6.8-7.5)	7 (6.8-7.4)	7 (6.5-7.3)	7.2 (7-7.5)	7.1 (6.9-7.5)	7 (7-7.2)	
10.5 (10.3-11.2)	10.2 (10-10.6)	10.2 (9.7-10)	10.6 (10.3-10.9)	10.2 (10-10.6)	10.3 (10.2-10.4)	
9.4 (9.2-9.6)	9.03 (9-9.1)	9.3 (9-9.6)	9.5 (9.5-9.5)	9.3 (9.2-9.5)	9.3 (9.1-9.8)	
12 (11.5-12.4)	12.2 (11.8-12.5)	12.2 (12-12.6)	12.3 (12.1-12.5)	12 (11-12.8)	12.3 (12.1-12.4)	
13.5 (13-14)	13.4 (13.2-13.6)	13.3 (13-13.8)	13 (12.5-13.5)	13.6 (13-14)	13.6 (13.5-13.9)	
7.7 (7.5-8)	7.8 (7.1-8.3)	8.1 (7.2-8.5)	7.7 (7.5-8)	7.9 (7.7-8.4)	7.9 (7.4-8.3)	
13.1 (12.5-13.5)	13.1 (12.6-13.5)	13.1 (12.2-13.6)	13.2 (13-13.5)	13.4 (13.1-14.5)	13.6 (13.4-13.9)	
6.5 (6.3-6.7)	6.2 (6-6.5)	6.1 (5.7-6.5)	6.3 (6-6.5)	6.6 (6.5-6.8)	6.7 (6.5-6.8)	
5 (4.9-5.2)	5.1 (4.9-5.2)	4.7 (4.6-4.9)	4.6 (4.3-4.9)	4.8 (4.6-5.2)	4.9 (4.7-5.2)	
17.2 17-17.7	17.1 (16-17.9)	16.6 (15.5-17.5)	17 (16-17.6)	17.2 (17-17.8)	17.4 (17-17.8)	
4.8 (4.7-4.9)	4.9 (4.7-5.2)	4.8 (4.7-4.9)	4.7 (4.6-5)	5 (4.7-5.2)	4.8 (4.7-4.9)	
4.1 (4-4.3)	4.4 (4.3-4.6)	4.4 (4-4.6)	4.4 (4.3-4.6)	4.5 (4.3-4.7)	4.4 (4.3-4.6)	
4.75 (4.7-4.9)	4.76 (4.6-4.7)	4.66 (4.6-4.7)	4.7 (4.7-4.8)	4.7 (4.9-4.9)	4.7 (4.7-4.7)	
4.5 (4.3-4.6)	4.66 (4.6-4.7)	4.5 (4-4.7)	4.6 (4.6-4.7)	4.7 (4.6-4.9)	4.6 (4.6-4.6)	

Figure 2. UPGMA phenetic tree for 11 populations of *A. mystacinus* in Turkey, generated by NTSYS-pc.Table 2. Distance values for 11 populations of *A. mystacinus* in Turkey. See text for explanation of locality (population) abbreviations.

SEB	ULD	AKS	ÇML	ÇIĞ	BEB	AYİ	GKK	ALD	ARD	AKC	
SEB	0.000										
ULD	0.408	0.000									
AKS	0.397	0.418	0.000								
CML	0.407	0.402	0.412	0.000							
CIG	0.384	0.428	0.381	0.419	0.000						
BEB	0.374	0.373	0.402	0.358	0.404	0.000					
AYI	0.459	0.398	0.316	0.424	0.444	0.436	0.000				
GKK	0.479	0.489	0.506	0.407	0.488	0.497	0.536	0.000			
ALD	0.469	0.485	0.570	0.543	0.518	0.474	0.504	0.575	0.000		
ARD	0.374	0.408	0.371	0.413	0.489	0.413	0.357	0.544	0.506	0.000	
AKC	0.405	0.446	0.378	0.499	0.461	0.409	0.412	0.604	0.520	0.318	0.000

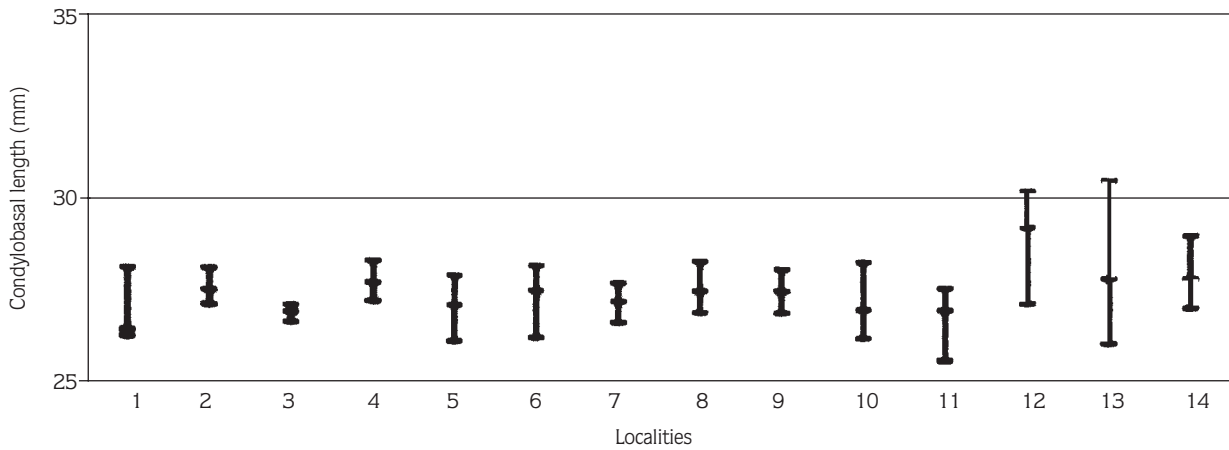


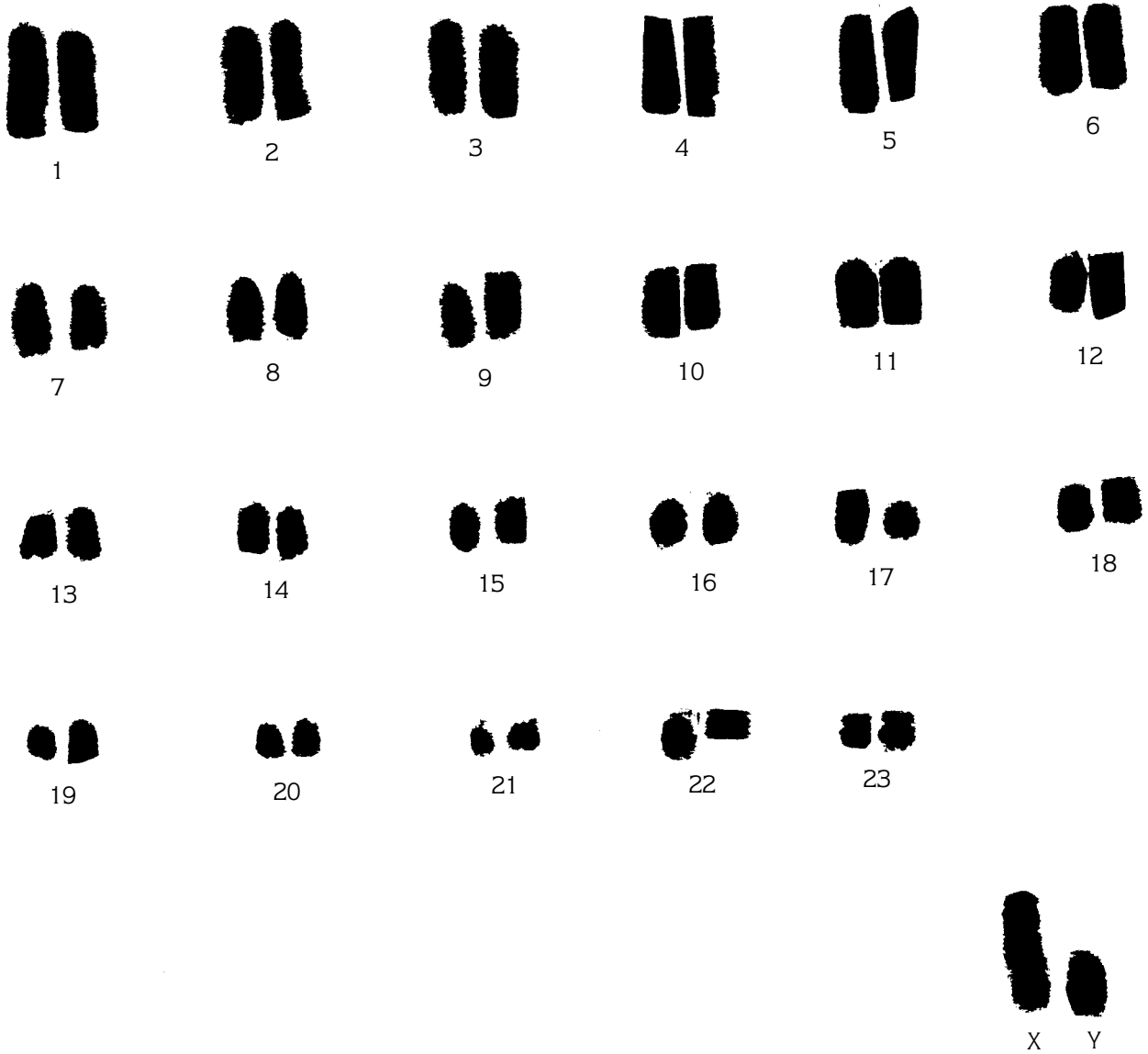
Figure 3. Scatter diagram of condylobasal length in *A. mystacinus*.
 1 Sebil, 2 Ardanuç, 3 Altındere, 4 Akçakoca, 5 Uludağ, 6 Aydın-İzmir-Manisa, 7 Beyşehir-Burdur, 8 Akseki, 9 Çiğlikara, 10 Çamalan, 11 SE Turkey, 12 *A. m. epimelas*, 13 *A. m. symnensis*, 14 *A. m. rhodius*

Table 3. A comparison of subspecies of *A. mystacinus* in Turkey and Greece. (C: Characters; T: Taxa). See text for explanation of measurement abbreviations.

C	T	<i>A. m. mystacinus</i> **	<i>A. m. euxinus</i> **	<i>A. m. epimelas</i> *	<i>A. m. smyrnensis</i> *	<i>A. m. rhodius</i> *
L		238 (215-261)	240 (220-265)	252 (225-275)	228.2 (197-254)	
T		125.73 (115-137)	124 (112-142)	134.13 (114-152)	120.7 (104.3-135.5)	128 (118-137)
HF		26.3 (25-28)	26 (25-28)	27 (25-28)	24.7 (23.1-27.8)	25.8 (25-26)
E		21 (18-25)	19.5 (16-22)	22 (21-23)	18.6 (16.3-20.9)	20.3 (19-23)
W		34 (20-52)	34.8 (23-42)	56 (37-66)	37.1 (28-58)	
ZB		14.8 (14-15.5)	15.5 (15-16)	16 (15.5-16.4)	14.7 (13.7-15.8)	
IC		4.5 (4.4-4.7)	4.5 (4.1-5.1)	4.7 (4.6-5)	4.4 (4-4.89)	
CBL		26.8 (26.1-28)	26.8 (26.5-27)	29.2 (27.1-30.2)	27.8 (26-30.5)	27.8 (27-29)
ONL		30.4 (29.7-31.5)	30.2 (29.5-31)	31.9 (30.5-33.1)		
BL		25 (24-26.1)	25.6 (24.9-27)	24.9 (23.2-25.5)		
NL		11.3 (10.5-12.1)	11.7 (10.7-12.9)	12.4 (11.5-13.1)	11.6 (10.4-13.7)	
D		7.8 (7.6-8.2)	7.7 (7.5-8)	8.5 (8.4-8.8)	7.3 (6.4-8.5)	
LUT		4.4 (4.3-4.6)	4.4 (4.3-4.6)	5.1 (4.8-5.3)	4.9 (4.6-5.2)	
LLT		4.5 (4.3-4.6)	4.6 (4.6-4.7)	4.9 (4.6-5.2)	5 (4.8-5.3)	

* from Ondrias (1968)

**from type locality

Figure 4. Karyotype of male *A. mystacinus* from Ardanuç.

contrast to Danford and Alston (1977), we found that the under parts of specimens from the type locality were pure white ($n = 4$) or grayish white ($n = 4$). According to Ellerman (1948), in *A. m. mystacinus* dorsal coloration is paler, and the under parts are usually lighter, to white. The color description and measurements given by Ellerman (1948) are consistent with those of specimens from the type locality of *A. m. mystacinus* in the present study. However, the palatal length is shorter than that in the present study. Harrison and Bates (1991) referred to specimens from Syria, Iraq, Lebanon, Israel and Jordan as

A. m. mystacinus, and described the coloration; the under parts are pure white, the line of demarcation on the flanks is sharp, the hair bases are dark plumbeous throughout, but less extensive on the ventral surface, and the dorsal surface of old adults becomes dull brown, variably washed with black. Although both the colour description and measurements given by Harrison and Bates (1991) for *A. mystacinus* are consistent with those of *A. m. mystacinus* from Turkey, the ear length is shorter (similar to that of *A. m. euxinus*) than that in *A. m. mystacinus* in Turkey. According to Neuhäuser

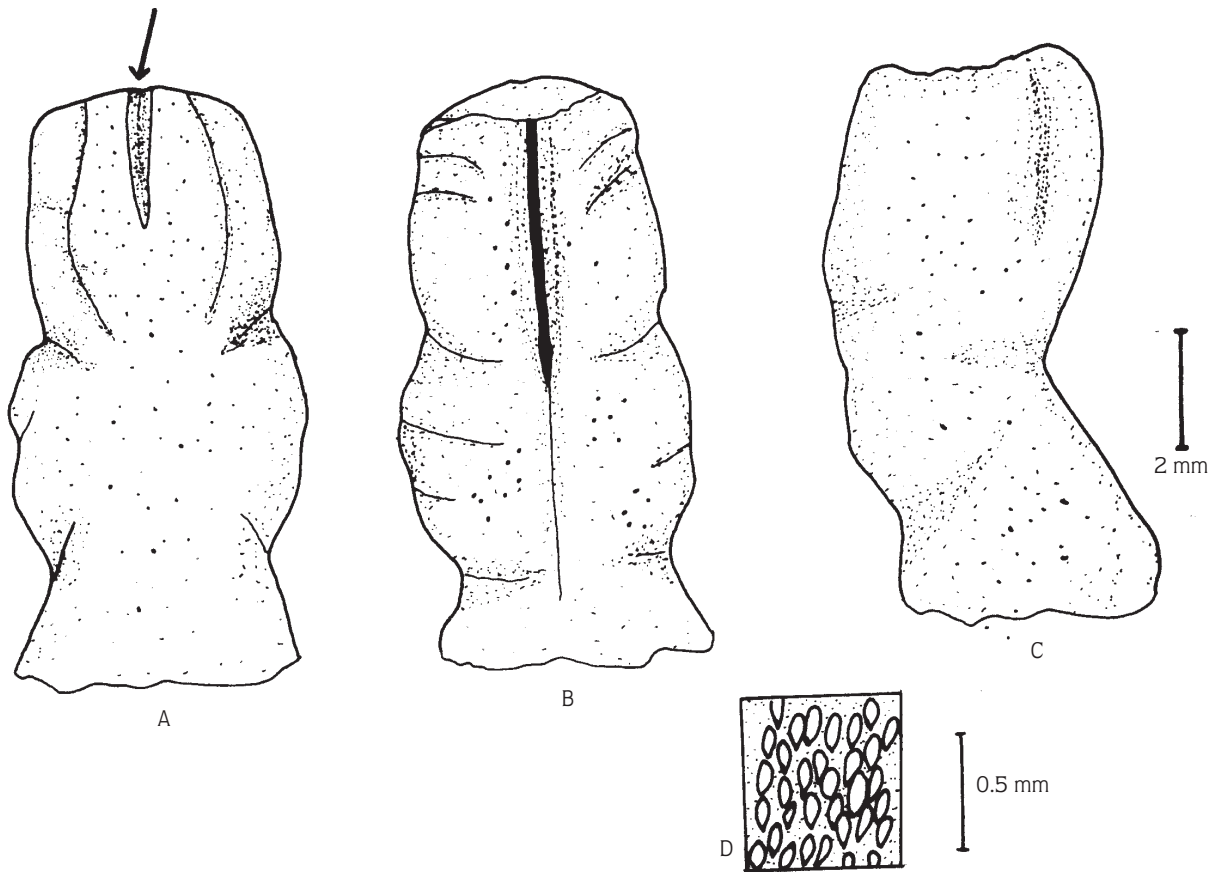


Figure 5. Phallus of *A. mystacinus* from Sebil. A. Dorsal, B. Ventral, C. Lateral view. D. Epidermal structures of dorsal region. Arrow indicates short groove.

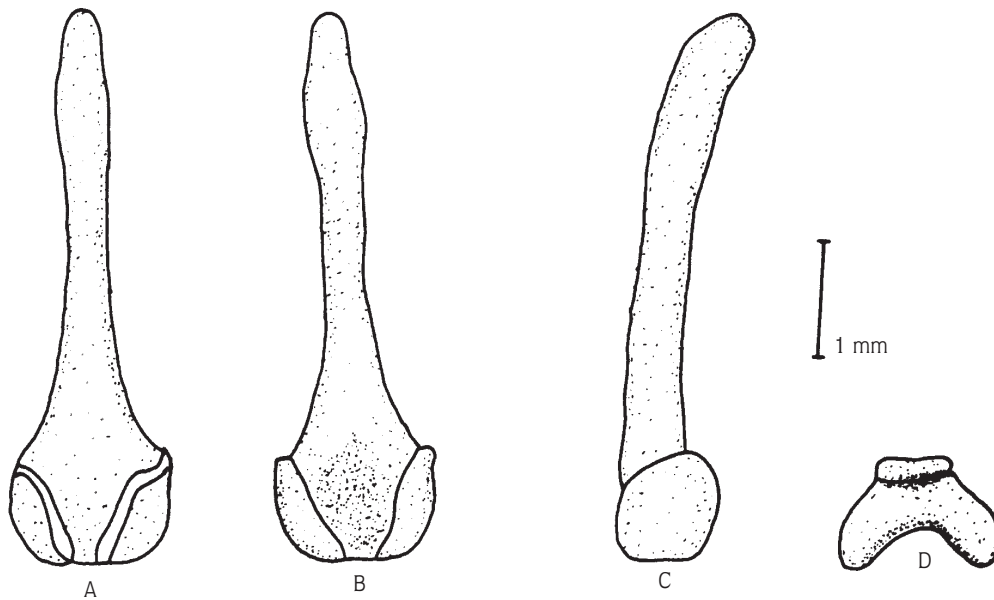


Figure 6. Baculum of *A. mystacinus* from Altindere. A. Dorsal, B. Ventral, C. Lateral, D. Basal view.

(1936), who examined specimens of *A. mystacinus* from Smyrna, Karadağ and Elmalı, *A. m. mystacinus* is distributed from the Taurus to northern Syria, and *A. m. smyrnensis* is distributed from western Anatolia to the Taurus. Measurements given by Neuhäuser (1936) are similar to those given in the present study for all specimens of *A. mystacinus* in Turkey. According to Ondrias (1966), the under parts of *A. m. epimelas* are grayish, and large. This color description given by Ondrias (1966) for *A. m. epimelas* is similar to the under part coloration of *A. m. euxinus* rather than to that of *A. m. mystacinus*. Measurements given by Ondrias (1966) are greater than those of Turkish subspecies (Table 3). Thomas (1903) described *A. m. smyrnensis* from Smyrna by white belly coloration. In respect of skull measurements, Ondrias (1966) pointed out that *A. m. smyrnensis* was significantly different from the typical subspecies, and statistically larger than *A. m. euxinus*. According to Ondrias (1966), in *A. m. smyrnensis*, the upper parts are grayish brown yellowish, the under parts are poor with pale gray underfur, the condylobasal length is less than 28 mm, the hind foot is about 25 mm long, and the ear is less than 19 mm long. We compared these characters of *A. m. smyrnensis* to Turkish subspecies of *A. mystacinus* (Table 3), and found that the average condylobasal length of *A. m. smyrnensis* was greater than that of Turkish forms, especially of typical specimens of *A. m. mystacinus*, and that average hind foot and ear values are less than those of Turkish forms. We also compared the characteristics given by Ondrias (1966) for *A. m. smyrnensis* those for with specimens from Aydın, İzmir, and Manisa near to the distribution area of *A. m. smyrnensis*. The belly coloration of specimens with pure white bellies from Aydın, İzmir, and Manisa was different from the belly coloration of the specimens examined by Ondrias (1966). Moreover, the average ear length of specimens from Aydın, İzmir, and Manisa was the same as those of specimens reported by Ondrias (1966), and of typical specimens of *A. m. euxinus*. Neuhäuser (1936) determined a feature of white belly coloration of *A. m. smyrnensis* in specimens from Murat Dağı, Kara Dağ and Elmalı. We also observed this feature in specimens from both Anatolia and the type locality of *A. mystacinus*. Ondrias (1966) distinguished *A. m. rhodius* from *A. m. smyrnensis* in pelage coloration by the brownish fur along the back. According to Ondrias (1966), in *A. m. rhodius* the underfur is grayer, and whiter in *A. m. smyrnensis*. In terms of body and skull measurements, the only

distinguishing measurements are the greater ear length of *A. m. rhodius*, the underparts are whitish, and grayish at the base of hairs, and the ear is about 20 mm long. These characters are consistent with those of typical specimens of *A. m. mystacinus*.

Ellerman (1948), who examined specimens from Sebil, Smyrna, Karadağ, and Murat Dağı, including one from Rhodes, and Doğramacı (1972), who evaluated specimens of *A. mystacinus* in Turkey, indicated that *A. m. smyrnensis* and *A. m. rhodius* were synonymous with *A. m. mystacinus*. According to Doğramacı (1972), *A. m. mystacinus* and *A. m. euxinus* live in Anatolia, and *A. m. mystacinus* differs from *A. m. epimelas* in Balkan subspecies by dorsal coloration. We examined and compared all specimens of *A. mystacinus* in Turkey. The results of the present study showed that *A. m. mystacinus* was different from *A. m. epimelas*, and similar to *A. m. euxinus*, even if *A. m. euxinus* is moderately dark in coloration, and that *A. m. smyrnensis* and *A. m. rhodius* were synonymous with *A. m. mystacinus*.

According to Vohralik et al. (2002), there is a considerable difference between Asian and European *A. mystacinus* populations, and Asian populations are fairly homogeneous. Our data support those of Vohralik et al. (2002). In addition, Vohralik et al. (2002) did not confirm the validity of *A. m. euxinus*. We examined 19 specimens from the type locality (Altındere) of *A. m. euxinus*. The dark coloration and UPGMA cluster distinguish this form from *A. m. mystacinus*. In contrast to the studies mentioned above, Verimli et al. (2000) determined differences between 3 populations of *A. mystacinus* from western Anatolia, Akseki, and Ardanuç based on electrophoretic aspects of blood serum proteins. Verimli et al. (2000) observed 2 bands in the prealbumin zone of specimens from western Anatolia, 3-4 bands in those from Akseki, and 4 bands in those from Ardanuç. Nevertheless, in order to resolve the subspecific problem in *A. mystacinus*, further genetic research, such as allozyme and mt DNA studies, is needed.

We karyotyped specimens from Sebil, Akseki, Çiğlıkara, Sümela, Ardanuç, Akçakoca, Beyşehir and Kemalpaşa (İzmir). Karyological findings obtained in the present study are consistent with those reported by Doğramacı and Kefelioğlu (1991) for *A. mystacinus* in Sebil (n = 3), İzmir (n = 4), and Altındere (n = 1) in Turkey.

We determined a difference between phallus given by Williams et al. (1980) for *A. mystacinus* from Posedarje (Croatia) and that reported by this study for Turkish populations. In contrast to Williams et al. (1980), there is a groove in the dorsal aspect at the tip of the phallus, and a long groove extending ventrally along the phallus of all specimens examined. This difference between the European and Asian populations is large, and supports the specific status of *A. epimelas*, as in the studies by Mezhzherin (1997), Filippucci et al. (2002), and Vohralik et al. (2002). The basal end of the baculum figured by Harrison and Bates (1991) for *A. mystacinus* from Lebanon is pointed, while it is rounded in Turkish populations.

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